RHIC Machine Status

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RHIC AGS User Group Meeting
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Run- 4 star- up and ramp- up

- 12/01/03 2 weeks of start−up begin
  (24h/day machine development)
- 12/15/03 2 weeks of ramp−up begin
  (owl shift for experiments)
- 12/31/03 Physics Run started

Comments:
- Ramp−up period 1 week shorter than planned
- Total of 8 days with larger problems during start−up/ramp−up
- Started Physics Run with
  - stores above design luminosity
  - ~40(μb)$^{-1}$/week (last week in Run−2 had 24(μb)$^{-1}$)

[luminosity numbers denote delivery to Phenix/Star]

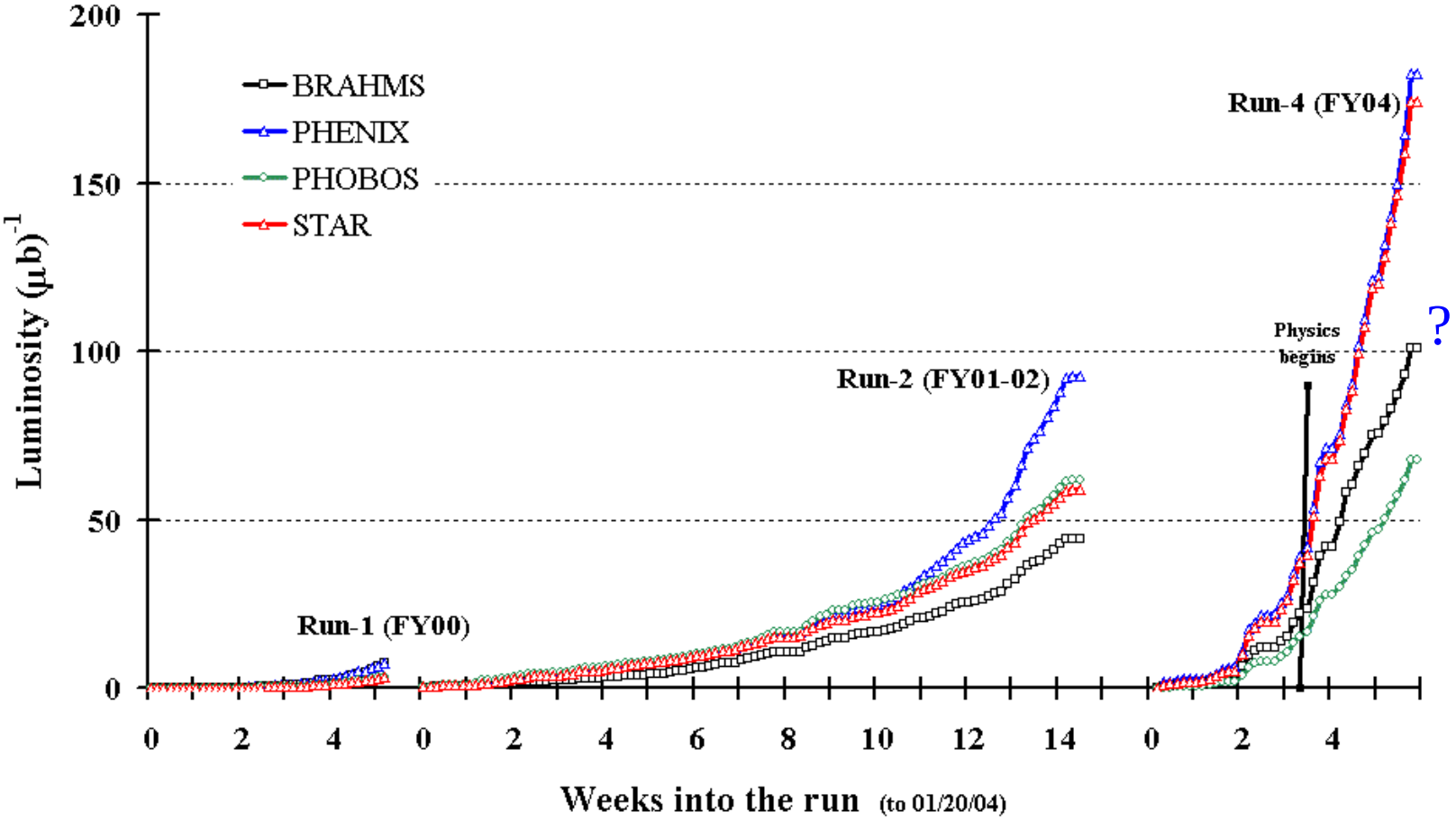
Run- 4 luminosity evolution

Delivered 182.5 $(\mu b)^{-1}$ to Phenix [109.8]

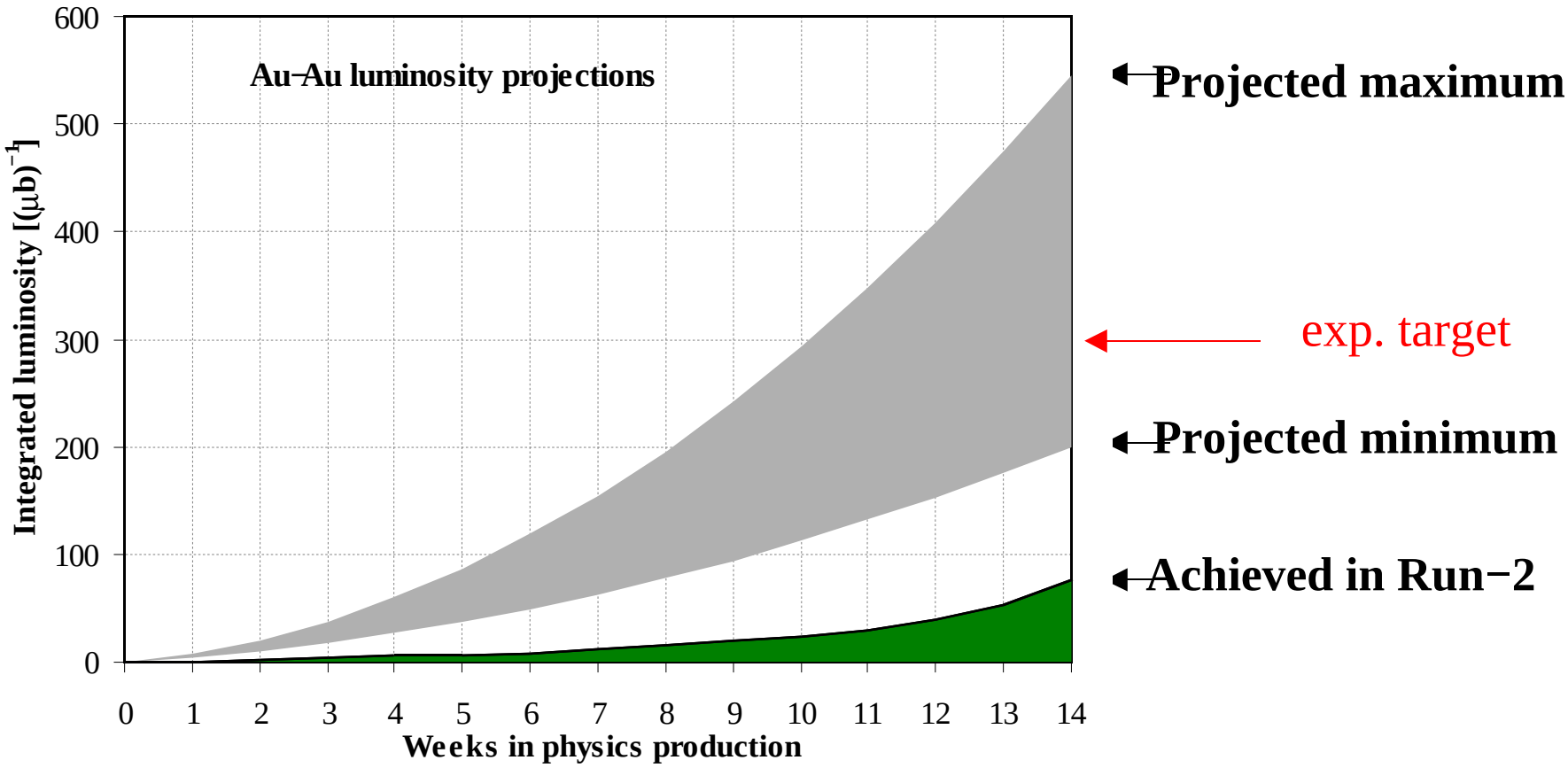
72.7 $(\mu b)^{-1}$ last week [42.4]

Target 330 $(\mu b)^{-1}$

Star ×0.9
Phobos ×0.3
Brahms ×0.5?



Projected Run−4 Au−Au Luminosity Evolution



- Experimental target luminosity > 3x higher than achieved in last Au−Au run with the same time!

Run- 4 current typical running conditions

Sat 01/17/04 Current typical running conditions (under consideration at all times):

Quantitiy	Unit	Value	Comment
Bunch intensity	10^9 Au ions	**1.0 / 0.7**	Blue / Yellow, injected
Number of bunches	...	**61**	per ring
Initial ZDC rates	kHz	**8.0**	at Phenix and Star, 1/3 at Brahms and Phobos
Initial luminosity	$10^{26}cm^{-2}s^{-1}$	**8.0**	at Phenix and Star, 1/3 at Brahms and Phobos
Luminosity lifetime	hrs	**2.5**	for first 3 hours of store, larger thereafter
Time between fills	hrs	**5.0**	for uninterupted production
Optimum store length	hrs	**3.8**	to maximize average luminosity, for uninterupted production

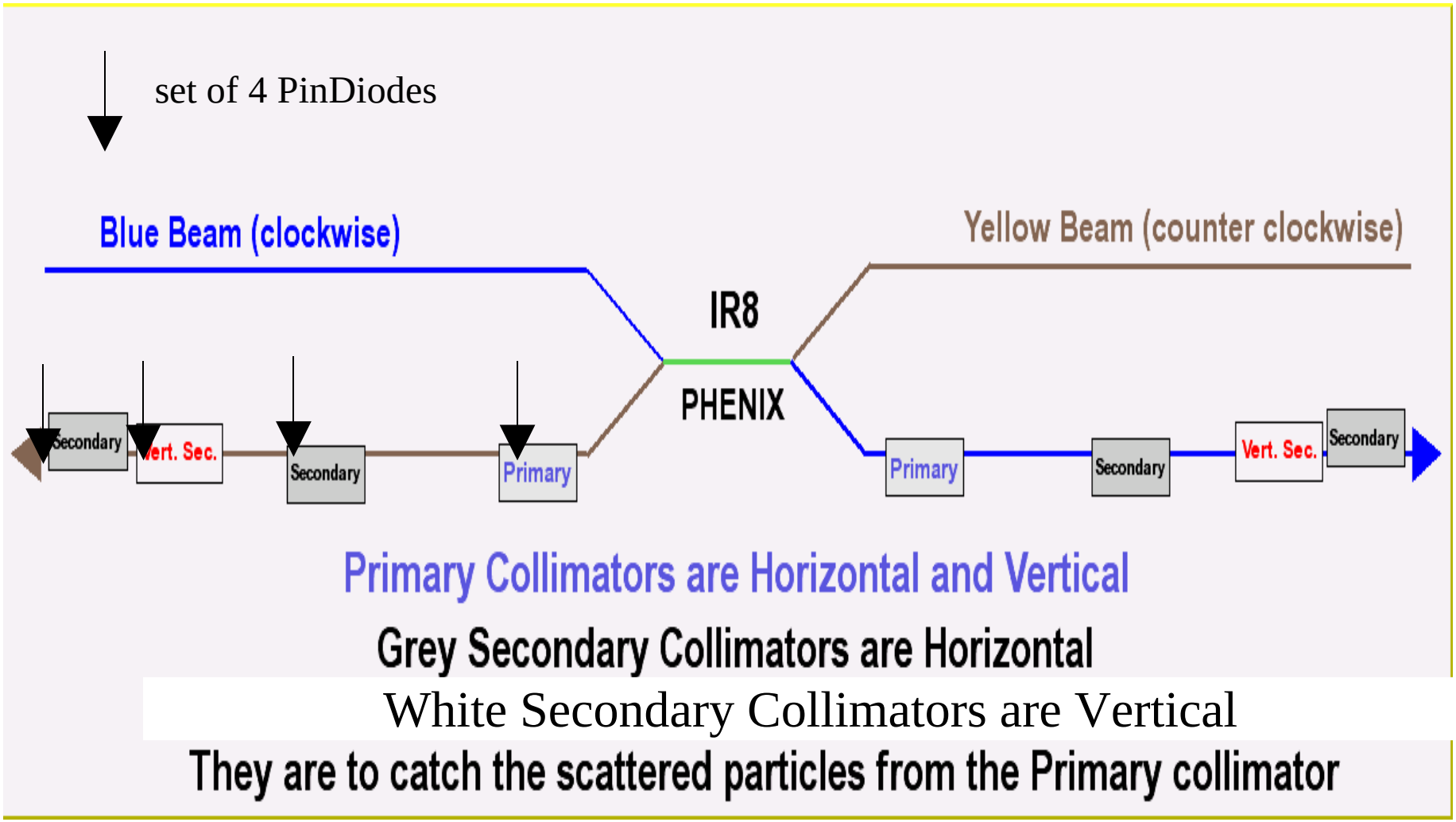
Comments:

- initial luminosity is 8x design
- average store luminosity is ~2x design (good stores)
- luminosity lifetime is dominated by IBS and beam−beam (no collision beam lifetime about 20 hours)
- time between fills has large variations (0.5 to 12 hours)

Run- 4 improvements: luminosity

- Better optics model
- Orbit correction after each ramp
- Flexible bunch patterns
  (almost all bunch numbers between 3 and 111, arbitrarily distributed)
- Better instrumentation
  (IPM, Schottky, PLL tune meter, BPMs −− still in progress)
- Low order nonlinear IR correction finished
- Continuous Gap Cleaning
- Better background reduction
  - Shielding for Phenix and Brahms
  - Horizontal 2−stage collimation in both rings
- Faster beginning−of−store activities
  - Automatic steering for all experiments ~5min
  - Automatic collimator settings (optimization still in progress)

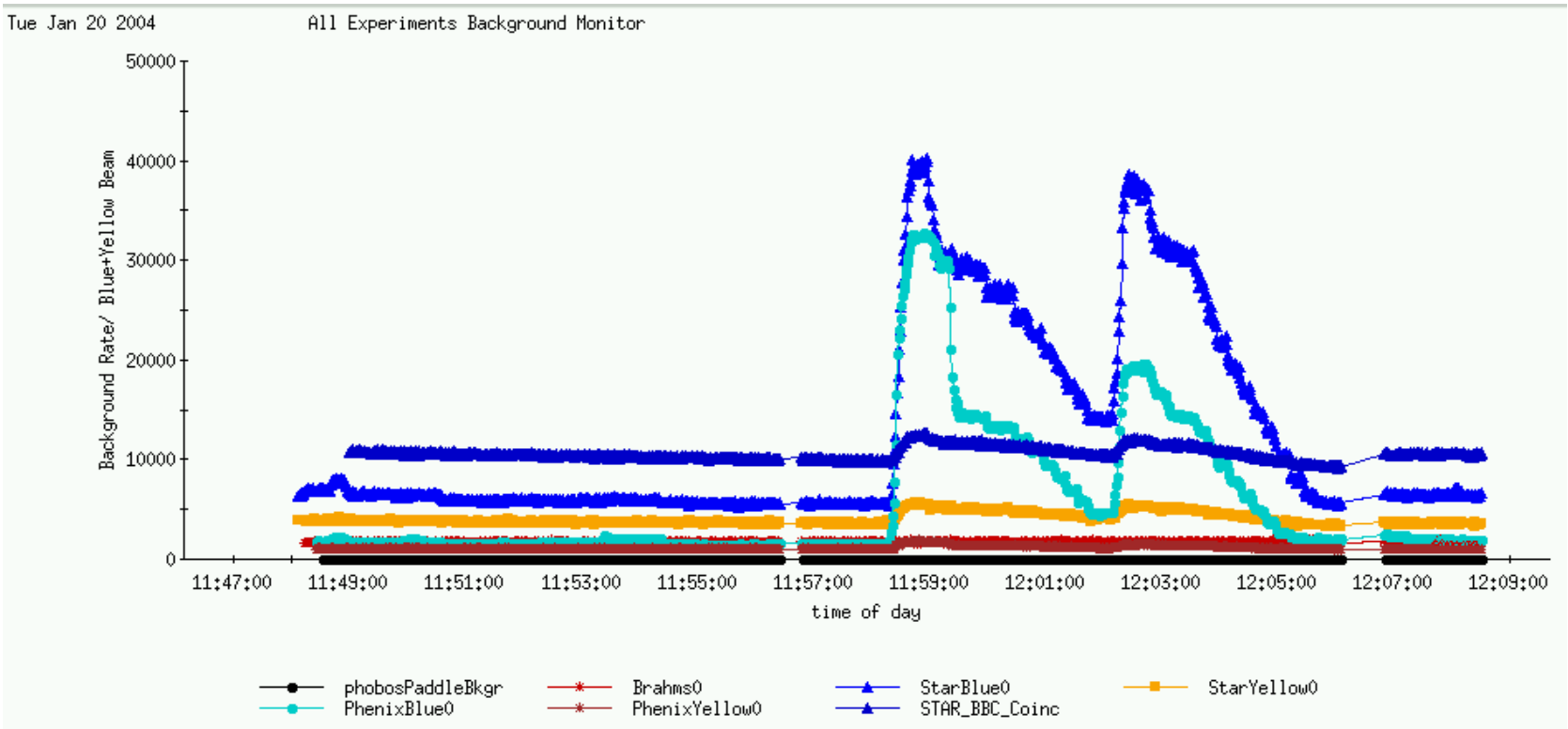
New Collimation System



Steering and motion of collimators (total of 18 motion channels!) automated by feedback based on signals from PinDiodes (loss monitors).

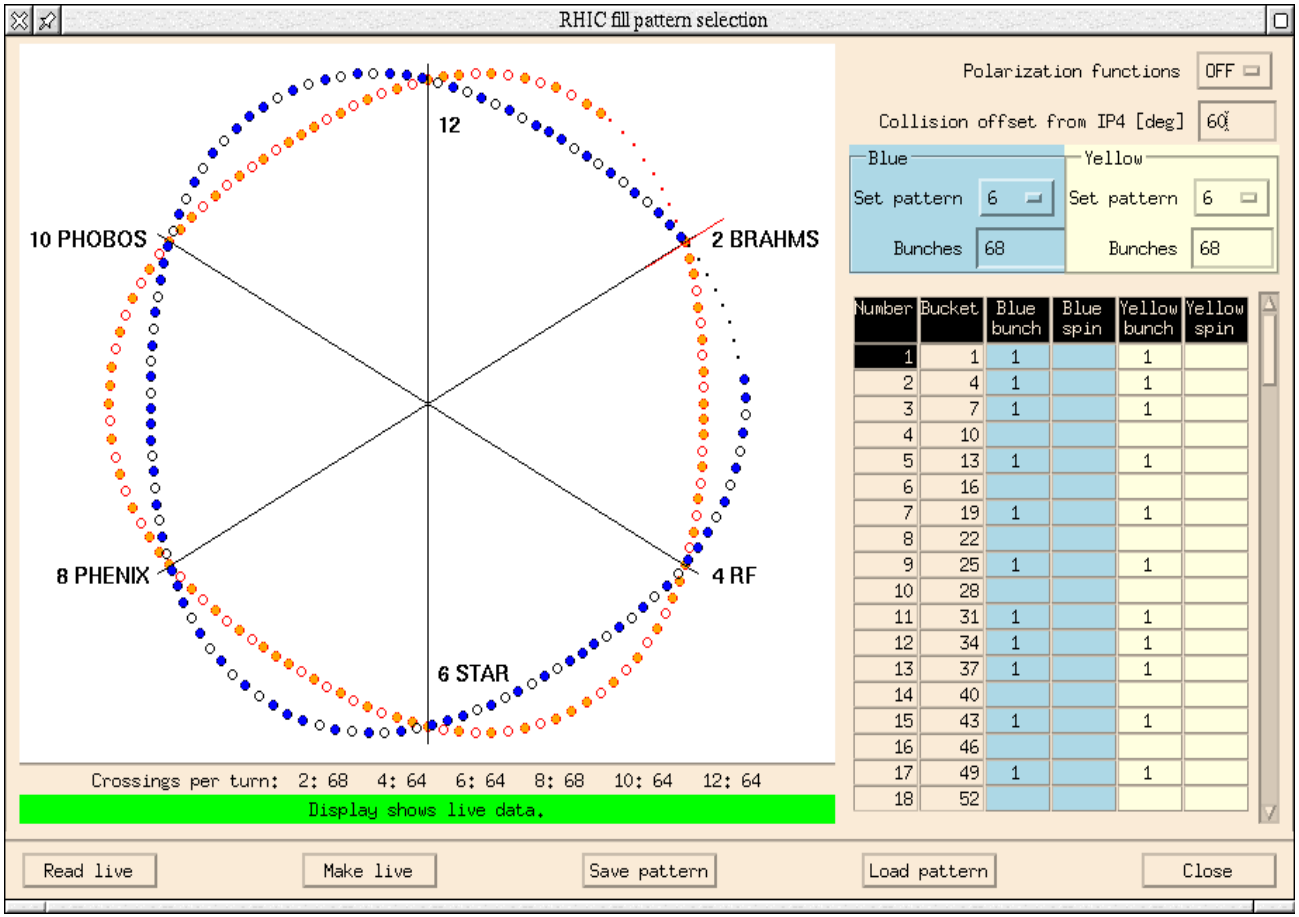
Status: collimators installed, software development done, optimization in progress

New Collimator Performance



Reduction is in the order of x10 (have seen even better :))
times achieved: ~3 minutes
working on feedback using exp. background signals

Flexible Bunch Patterns

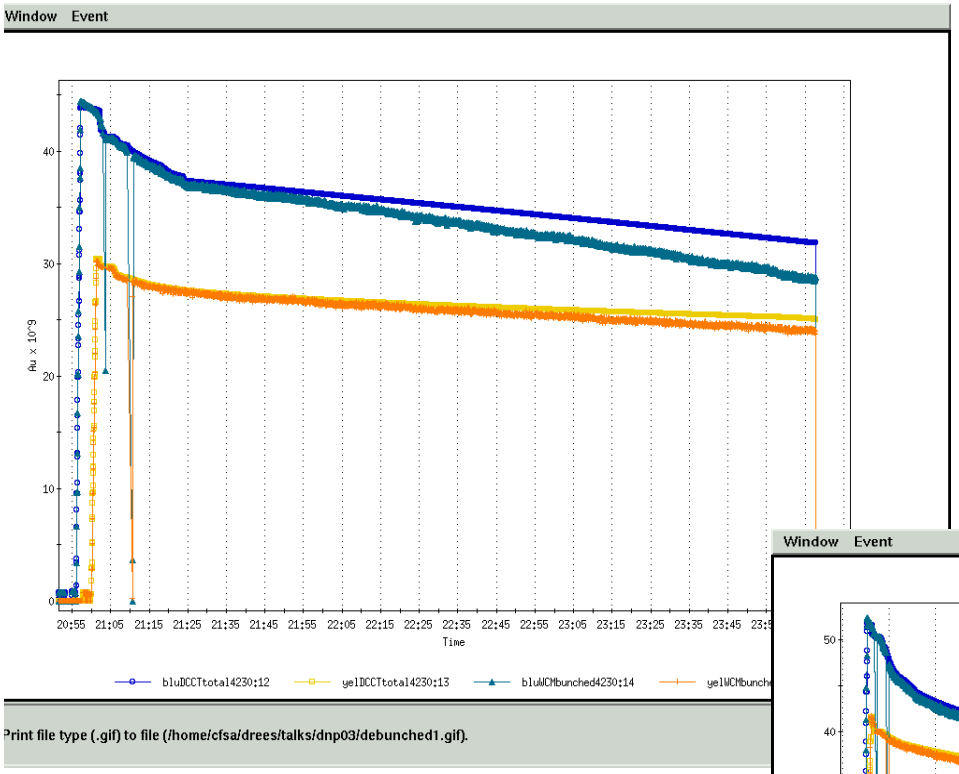


Use a combination of 60-bunch and 120−bunch fill patterns by injecting bunches into 3rd and 6th buckets. Total number of bunches is:

55 < 68 < 110

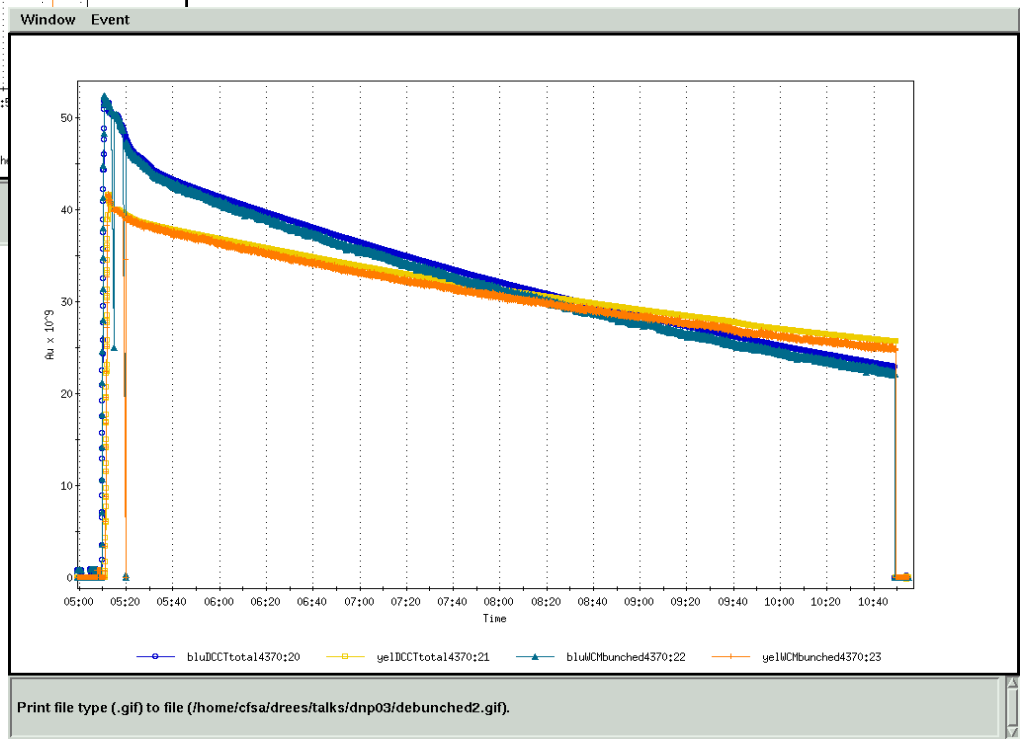
Increase is 20% per ring.

Gap Cleaning Performance

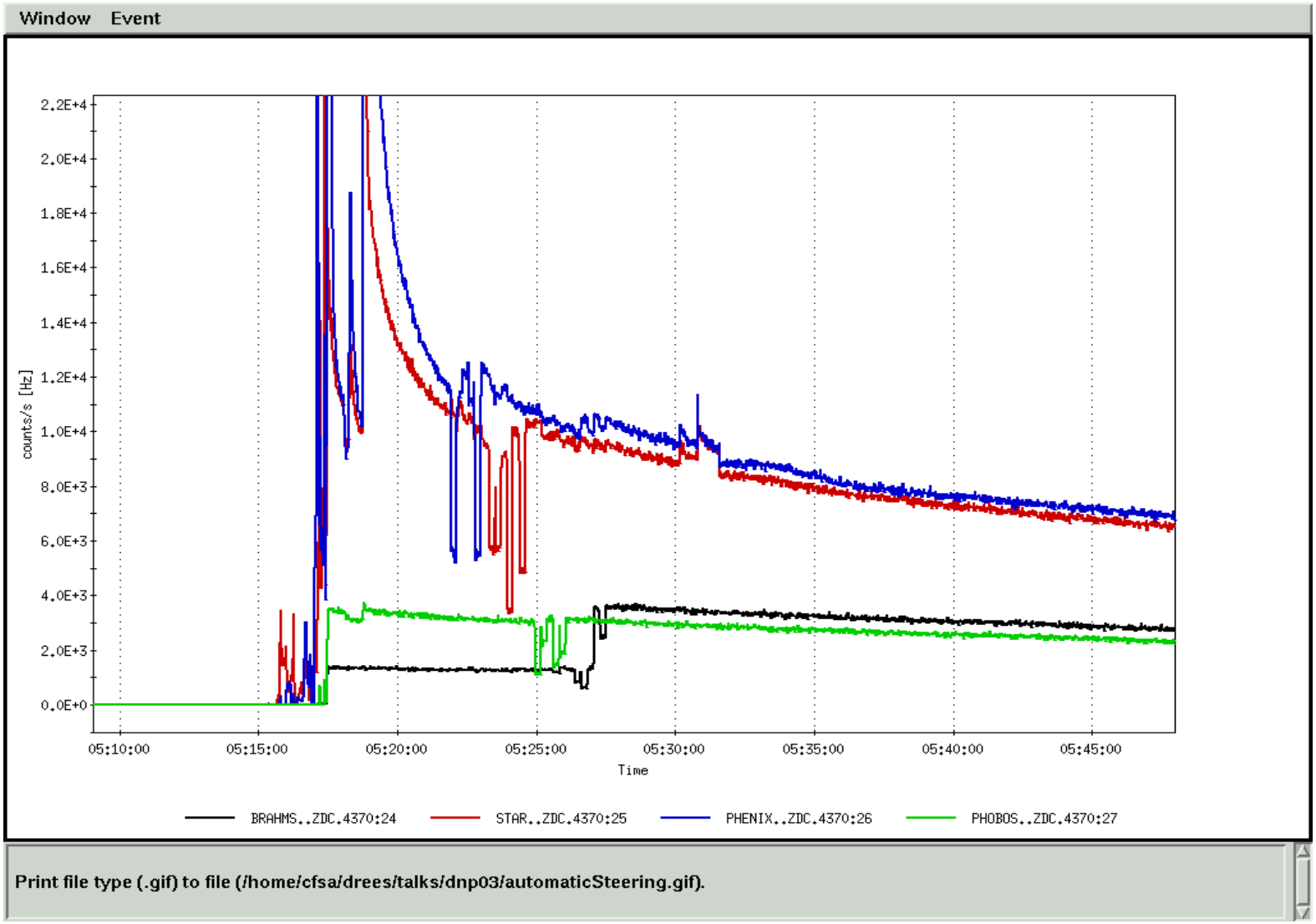


no gap cleaning

continuous gap cleaning



Automatic Steering (with LISA)



Timescale: ~ 5 minutes, maintaines optimum rates for experiments

Run- 4 improvements: time in store

- More efficient operation
  - Faster down ramps
  - Faster quench recovery (refrigerator)
  - Higher loss limits on ramp (fewer ramps aborted)
  - Fast access from home (more analysis power available)
  - Phobos magnet controlled by Sequencer/MCR
- Increased reliability
  - AtR, starved microbes in cooling water
  - Much reduced ice ball maintenance
  - Corrector power supplies

FY04 Improvements and Status

- Collimation system upgrade and feedback (−> done)
- Upgraded gap cleaning technique (−> done)
- Shielding @ BRAHMS and PHENIX (−> done)
- flexible bunch pattern (−> done)
- online modelling, “bump” closure (−> done)
- Vacuum (−> part. done)
- Automated Luminosity Steering (LISA) (−> done)
- BPMs (reliability), Instrumentation (−> part. done)
- Hardware changes to reduce recovery and maintenance (quench protection, ice balls, fast down ramps) (−> done)
- Faster/more user friendly operations tools (ramp analysis, more automation) (−> done)

Luminosity limitations

- Vacuum
  - Yellow stochastic cooling kicker yo4, now baked
  - Blue collimators bi8
  - Blue instrumentation section bo2
- Intrabeam scattering
  - At injection:
    - Longitudinal emittance increase
    - Debunching
  - At store:
    - Debunching
    - Transverse emittance increase
- Beam−beam interaction
- Background

Luminosity lifetime: ~2.5hrs
Beam lifetime without collisions: ~20 hrs

Summary

- Run−4 start−up and ramp−up period
  one week shorter than planned
- Current gold−gold luminosity is about
  2x higher than at end of last gold−gold run
  (instantaneous, per store and per week)
- Most improvements for gold−gold operation
  will also benefit polarized proton operation